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Abstract

STUDY OF THE DYNAMIC BEHAVIOUR OF THE REACTOR "RAPSODIE"

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It is known that fast neutron breeder reactors pose new problems in the fields of mechanics and heat technology, as well as in respect to their dynamic behaviour and safety.

The reactor RAPSODIE has been the object of numerous dynamic studies on analogue and digital computors for two types of fuel (metal and oxide).

After elaborating the mathematical models representing the whole of the installation (reactor block and cooling circuit) from the point of view of neutrons as well as thermodynamics, the analogue diagrams and digital codes required for simulating incidents, control and stability of the reactor were established.

Considerable effort was made to obtain a greater precision than in the usual methods, either by using smaller intervals, or by the use of formulations

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closer to the real system, or even analytically soluble.

The study of incidents was carried out on analog computer for the whole system, and digital computer for the reactor block alone or the installation functioning with a single thermal circuit.

A special complementary programme - which so far as we know, was used for the first time here for sodium reactors - which takes into account the behaviour of the reactor beyond the boiling point of sodium was refined on the basis of some simplifying assumptions.

The investigation of incidents has served to determine :

- The intrinsic safety of the reactor, i.e. its behaviour under accident conditions without the intervention of the safety systems ;

- The behaviour of the installation under normal accident conditions, i.e. with the safety systems functioning, and the definition and organisation of the latter ;

- The comparison of the two versions investigated (metal or oxide fuel) for the choice of the first loading of the reactor ;

- The determination of thermal shocks (amplitudes and gradients suffered by the structures during probable incidents) to be used in the test on the full-scale model of the reactor.

The stability tests were carried out digitally. The investigation of the control, carried out on analog computer, served to determine the different possible means of starting and changing the conditions of the reactor as well as its automatic control.

The calculations were examined in the totality by the construction of a training simulator composed of a board similar to the control board of the reactor, all of whose commands (reactivity and flows) work on an analogue computer which resolves in the real time the dynamic equations of the reactor and which reproduces simultaneously all the parameters representing the state of the installation (power, period, temperatures, etc .) in the case of various incidents as well as under normal conditions of functioning.